Estimation of aerodynamic heating on super/hypersonic vehicles. Aerothermodynamic design principles for super/hypersonic vehicles.

Course Learning Outcomes (CLOs)

Use the 1st and 2nd laws of thermodynamics to calculate heat transfer, work done and entropy changes in a thermodynamic system.

2. *Use the equation of state and the definition of enthalpy to calculate thermodynamic properties*
3. *Calculate the isothermal and isentropic compressibility of a gas for given conditions.*
   Use thermodynamics and conservation equations to calculate flow parameters at various points of a flow field
   Calculate stagnation and critical conditions at various points of a flow field for isentropic flow, adiabatic flow, flow with heat addition and flow with friction
   Explain physically what happens to flow parameters when the flow (a) crosses a normal shock wave, (b) is heated or cooled and (c) is subjected to friction
7. *List the differences between a Mach wave and a shock wave*
   Explain the conditions under which you get (a) a bow shock in front of a body or a compression corner, and (b) an oblique shock at the nose of a body or at a compression corner
9. *Explain the differences between the flow over a cone and the flow over a wedge*
   Calculate the flow properties downstream of a Mach wave, an oblique shock wave, and a Prandtl-Meyer expansion wave
   Calculate the lift and drag on supersonic airfoils using shock-expansion theory
   Calculate the flow properties downstream of a reflected / refracted shock wave.
   Explain mathematically and physically the relationship between flow cross-sectional area and local Mach (or flow speed).
   Explain an (a) ideally expanded, (b) over-expanded and (c) under-expanded nozzle.
   Calculate the flow properties at various locations of an (a) ideally expanded, (b) over-expanded and (c) under-expanded nozzle
16. *Calculate the location of a shock in a Laval nozzle (assuming there is one).*
    Design a supersonic / hypersonic wind tunnel (i.e., select the appropriate reservoir, throat and nozzle exit conditions to get the desirable test section conditions).
18. *Identify when heat transfer occurs as conduction, convection, or radiation.*
19. *Setup and solve conduction problems using Fourier's Law.*
    Explain the difference between natural and forced convection, and the tradeoffs associated with them.
21.

Other Readings

Handouts and Instructor's slides posted on Canvas. Additional research and material will be required for the completion of the final project if assigned

Other technology requirements / equipment / material

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- *Specific rules for the exam will be communicated in class and posted on Canvas on the day of the announcement.*
- *Neither rescheduled nor make-up exams will be allowed unless a written verification of a valid excuse (such as hospitalization, family emergency, religious observance, court appearance, etc.) is provided.*

Grading Information

Grades	Percentages
plus	
minus	
plus	
minus	
plus	
minus	

I will try to respond to any academically related inquiries within one business day. Any inquiries sent over the weekend or on a holiday will be resolved on the following business day.

Academic Integrity

Students who are suspected of cheating during an exam will be referred to the Student Conduct and Ethical Development office and depending on the severity of the conduct, will receive a zero on the assignment or a grade of F in the course. Grade Forgiveness does not apply to courses for which the original grade was the result of a finding of academic dishonesty.

University Policies

AE Department and SJSU policies